Amendment to the Specification

Please amend paragraph [0006] of the specification as indicated in the replacement paragraph presented below:

[0006] Towards providing these and other advantages, the present invention provides an annulus for a pipe-in-pipe electrically heated pipeline having an electrically and thermally insulating ~~ring~~ sleeve over the inner pipe in selected segments of the annulus, with a gap between the ~~ring~~ sleeve and the outer pipe. The ~~ring~~ sleeve is preferably made of polyurethane foam with an impermeable plastic skin on the outside surface. The inside pipe may be coated with fusion bonded epoxy. The weld joints in the inside pipe may be covered with half-shells, also made of foam. In parts of the annulus where greater thermal insulation is needed, more of the annulus contains the insulating ~~ring~~ sleeve. If no thermal insulation is needed, the insulating sleeve may be omitted and insulating pipe centralizers be used.

Please amend paragraph [0016] of the specification as indicated in the replacement paragraph presented below:

[0016] Figure 2 illustrates one embodiment of an electrically heated pipe-in-pipe pipeline. In the embodiment shown in Figure 2, pipeline 10 includes electrically conductive outer pipe 32 and electrically conductive product flowline or inner pipe 34 arranged concentrically. Annulus 36 is defined between inner pipe 34 and outer pipe 32. Insulating joint 38, which is normally in proximity to platform 14, structurally joins and electrically insulates inner pipe 34 from outer pipe 32. Electrical power supply 40 is connected across inner pipe 34 and outer pipe 32. Thus pipe-in-pipe flowline 10 serves as a power transmission line, with the circuit completed by an electrical pathway connecting inner pipe 34 and outer pipe 32 at a second end 44 of the pipeline, which is normally in proximity to sled 20. By transmitting power, the entire heated segment of pipeline 10 serves as an electrical heater. The connection for joining the inner and outer pipes is provided by electrically conductive bulkhead 46. In another embodiment, ~~insulating joint 38 is placed between two bulkheads and~~ electrical power is input at an intermediate point, which may be near the midpoint of pipeline 10, with electrical pathways completing the circuit on both ends of pipeline 10.

Please amend paragraph [0017] of the specification as indicated in the replacement paragraph presented below:

[0017] To prevent electrical shorts across annulus 36, inner pipe 34 must be electrically isolated from outer pipe 32 along the entire length of heated segment 10 except at bulkhead 46. ~~Carrier~~ inner pipe 34 may be thermally insulated to minimize heat loss and to reduce the amount of electrical power necessary to heat the contents of the pipe. Since electrical current flow is the same over the length of pipeline 10 and water temperature decreases with increasing water depth, the preferred amount of thermal insulation in different portions of riser 18 may vary. This may lead to the need for different annulus designs in different portions of pipeline 10. A design having less thermal insulation may be desirable for at least a portion of riser 18.

Please amend paragraph [0019] of the specification as indicated in the replacement paragraph presented below:

[0019] Inner pipe 34 is further thermally and electrically insulated by insulating ring 62, which surrounds inner pipe 34 and ~~layer~~ coating 90 and extends a selected distance along the length of inner pipe 34. Insulating ~~ring~~ sleeve 62 is preferably made of a thermally and electrically insulative material such as polyurethane foam. Insulating ~~ring~~ sleeve 62 also serves to centralize inner pipe 34 within outer pipe 32, and may be formed by spraying on of an insulating foam material around inner pipe 34. Insulating ~~ring~~ sleeve 62 may also have solid skin 64 on its outer surface that serves to protect insulating ~~ring~~ sleeve 62 from mechanical damage during installation. Solid skin 64 may be used to provide a water barrier that protects insulating ~~layer ring~~ sleeve 62 if insulating ~~ring~~ sleeve 62 is porous and to provide an additional layer of electrical insulation. Examples of the material of solid skin 64 are polyurethane and polyethylene. A small clearance between solid skin 64 and outer pipe 32 reduces heat loss from inner pipe 32 by decreasing convection in annulus 36. ~~The~~ Minimizing the clearance between solid skin 64 and the inner surface of outer pipe 32 is preferably less than about 0.25 inch.

Please amend paragraph [0022] of the specification as indicated in the replacement paragraph presented below:

[0022] In order to reduce the mechanical stress on either inner pipe 34 or outer pipe 32 during pipe laying (placing the pipe on the seafloor), mechanical stress is preferably transferred

between pipes. This load sharing may be provided by plug 104. Because plug 104 is selected to ~~seal~~ fill the annulus and adhere to the surfaces of both the outer wall of inner pipe 34 and the inner wall of outer pipe 32, it provides the necessary load-sharing.

Please amend paragraph [0024] of the specification as indicated in the replacement paragraph presented below:

[0024] Because plug 104 should adhere to the outer surface of inner pipe 34, insulating ~~layer ring~~ sleeve 62 and solid skin 64 are removed from inner pipe 34 along the length of plug 104. Removal of ~~layer~~ sleeve 62 should be minimized to maximize thermal and electrical integrity. For example, in the embodiment shown in Figure 3, which is designed to operate at sea water pressures near 1500 psi, 5 feet of insulating ~~layer ring~~ sleeve 62 are removed to accommodate a 2-ft plug. During installation, care should be taken to avoid contamination by lubricants or other substances of pipe surfaces that will be in contact with plug 104. These substances may prevent plug 104 from properly adhering to pipe surfaces.

Please amend paragraph [0029] of the specification as indicated in the replacement paragraph presented below:

[0029] Although a large amount of water in annulus 36 may lead to a catastrophic failure because it may form an electrical short between inner pipe 34 and outer pipe 32, it is possible and prudent to design annulus 36 so that small amounts of water will not lead to a system short. Small amounts of water may be present in annulus 36 due to condensation of water vapor in annulus 36 or due to rain and seawater that may enter annulus 36 during the installation of pipe-in-pipe pipeline 10. The main concern with water arises in quads that do not lie horizontal. As shown in Figure 3, in non-horizontal quads, any water present in annulus 36 will run down and collect on impermeable seal 108, where it can cause a short circuit across annulus 36. This problem is not normally present in horizontally oriented quads because water will spread along the bottom of annulus 36 for the entire length of pipe-in-pipe flowline 10 between two water stops and will not bridge from outer pipe 32 to inner pipe 34. In order to prevent the collected water from forming a short circuit in the non-horizontal portion of the pipeline, one or more electrically insulating collars shown in Fig. 3 as electrically insulating collars 112 and 114 may be formed on seal 108 to reduce pooling of water across annulus 36. Electrically insulating

collars 112 and 114 allow a certain amount water to collect on either side or the collars without shorting the annulus. One collar may also be used. The preferred height of collars 112 and 114 is determined by the amount of water that may be in the annulus. Collars 112 and 114 are preferably made tall enough to allow several hundred grams of water to collect without causing a short circuit. A suggested height range is about 1.5 to 3 inches, although other heights may also be suitable. A two-collar arrangement such as shown in Fig. 3 can accommodate <u>a packet of water absorption material, or </u>"super absorbent pack<u>"</u> 116 between the collars. Super absorbent pack 116 may be placed on top of seal 108 and held within rubber collars 112 and 114, which may be integral with seal 106. Super absorbent pack 116 traps water in the annulus and increases the amount of water that can be safely present in quads that are not horizontal. The use of super absorbent pack 116 can reduce the need for water-removal techniques, such as placing annulus 36 under vacuum between seals. Super absorbent pack 116 removes water (up to its capacity) from anywhere in the section of annulus 36 extending from impermeable seal 106 to the next impermeable seal above it. Super absorbent pack 116 may be formed from polyacrylates or other known super absorbents.

Please amend paragraph [0031] of the specification as indicated in the replacement paragraph presented below:

[0031] A shallower-depth design shown in Figure 4 may be employed in a selected part of riser 18 where water temperatures are higher and heat loss from the pipeline is less. This may include the upper-most quads of the riser section 18 (Figure 1). Figure 4 illustrates one embodiment of such apparatus in annulus 36. Insulating ~~layer ring~~ <u>sleeve </u>62 (Fig. 3) is omitted to avoid overheating during electrical power input. In the embodiment shown in Figure 4, centralizers 82 are used to provide electrical insulation and to centralize inner pipe 34 and outer pipe 32. Centralizers are most often cone-shaped wedges made of nonconductive materials. In one embodiment, centralizers may be composed of multiple parts such as described in US patent 6,142,707. Centralizers 82 may be present at selected intervals in annulus 36 along the entire length. The spacing may vary depending upon local conditions, but typically is about 10-20 feet, except at locations containing water stops. The materials of construction for centralizers 82 are selected such that they are able to withstand the voltages present across the annulus and such that they do not char if arcing occurs. DELRIN and NYLON are preferred materials for voltages up

to about 4000 volts. The outside surface of centralizers 82 may be beveled such that wet scale, possibly present in annulus 36, is unlikely to form an electrically conductive bridge between inner pipe 34 and outer pipe 32. Collar 84 may also be provided on the topside of the centralizers 82 to further block arcing resulting from any debris lying across the centralizers 82. ~~Carrier~~ inner pipe ~~32~~ 34 may also be surrounded by electrically insulating layer ring 86. Insulating layer ring 86 provides electrical insulation in case contamination does establish a bridge spanning from inner pipe 34 to outer pipe 32. Insulating layer ring 86 may be a layer of solid polyurethane, approximately 0.25 inch thick. Coating 90 of fusion-bonded epoxy may be present on inner pipe 34.

Please amend paragraph [0032] of the specification as indicated in the replacement paragraph presented below:

[0032] During heating, the applied electric power required and the calculated heating rate may be based on the assumption that the heated segment is on the sea floor and that a hydrate plug is residing in inner pipe 34. However, the upper quads of riser section 18 will heat up faster because of higher water temperature. Furthermore, inner pipe 34 will also not likely contain a hydrates in shallower-depth section 54 because near sea level the ambient temperature and internal pressure are usually not in the range of pressure-temperature when hydrates form. Thus, the quads in shallower-depth section 54 may overheat while in heating mode. If annulus 36 in shallower-depth section 54 exceeds a critical temperature, electrically insulating materials may break down resulting in an electrical short in the upper quads of riser section 18, where the voltages across annulus 36 are highest. By omitting insulating ~~layer ring~~ sleeve 62 in shallower-depth segment 54, the inner pipe temperature rise may be limited to about 20° F, because of higher heat loss. Although thermal insulation is not required in shallower-depth section 54, electrical insulation and load sharing between inner pipe 34 and outer pipe 32 may be needed.

END AMENDMENTS TO THE SPECIFICATION